



TETRA TECH

PHIL-25340

August 12, 2013

Project Number 04635

Mr. Brad White (3HS22)
U.S. Environmental Protection Agency (EPA) - Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Reference: Remedial Action Contract - EPA Region 3
EPA Contract Number EP-S3-07-04

Subject: Summary of Round 2 ISCO Injections
Valmont TCE Site
Long-Term Remedial Action (LTR)
EPA Work Assignment No. 052-LTRA-031M

Dear Mr. White:

As requested, enclosed is a brief summary of the Round 2 in-situ chemical oxidation (ISCO) injections at the subject site. Tetra Tech conducted this work in May 2013. A more detailed report will be prepared upon completion of the Round 2 post-injection monitoring program, which is currently underway.

Please contact me if you have any questions or comments.

Sincerely,

A handwritten signature in black ink that reads "Neil Teamerson".

Neil Teamerson
Project Manager

NT/pg

Enclosure

c: Mindi Snoparsky (EPA Region 3)
Vince Shickora (Tetra Tech)
File No. 3

ENCLOSURE

**SUMMARY OF ROUND 2 ISCO INJECTIONS
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA**

1.0 INTRODUCTION

This summary highlights Round 2 in-situ chemical oxidation (ISCO) injection activities at the subject site; provides the initial evaluation of pressure transducer results recorded during the injections; and briefly describes lessons learned during the injection field work. A more detailed report will be generated upon completion of the Round 2 post-injection monitoring program, which is currently underway.

2.0 INJECTION OPERATIONS

Permanganate injections, using a pre-mixed solution of 10% KMnO₄ in water, commenced May 20, 2013 and were completed May 31, 2013. Table 1 summarizes injection activities. Approximately 9,300 gallons of oxidant solution were injected into specific depth intervals in the bedrock beneath the site.

**TABLE 1
SUMMARY OF INJECTION ACTIVITIES
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA**

INJECTION WELL/ INTERVAL	HYDRAULIC PUMP UNIT PRESSURE (psi)	QUANTITY OF PERMANGANATE SOLUTION USED (gallons)	VOLUME OF WATER USED* (gallons)
E-1 May 20, 2013			
20-40 ft.	30	200	50
E-1 May 21, 2013			
20-40 ft.	36	889	210
MW-10A May 21, 2013			
36 – 46 ft.	20	136	15
E-7 May 21, 2013			
18-38 ft.	37	545	250
40-60 ft.	30	545	244
MW-11S May 22, 2013			
44-54 ft.	33	136	30
E-2 May 22, 2013			
32-52 ft.	13	609	0
70-90 ft.	70	7	0
90-110 ft.	85	62	0

TABLE 1
SUMMARY OF INJECTION ACTIVITIES
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA

INJECTION WELL/ INTERVAL	HYDRAULIC PUMP UNIT PRESSURE (psi)	QUANTITY OF PERMANGANATE SOLUTION USED (gallons)	VOLUME OF WATER USED* (gallons)
E-4 May 23, 2013			
30-50 ft.	31	1425	250
MW-22D May 23, 2013			
294-304 ft.	22	110	50
MW-18S May 28, 2013			
16-36 ft.	38	545	50
MW-28S May 28, 2013			
35-45 ft.	35	272	50
E-6 May 29, 2013			
95-115 ft.	115	130	15
E-9 May 29, 2013			
30-40 ft.	22	854	150
E-3 May 30, 2013			
40-60 ft.	45	950	250
E-2 May 30, 2013			
90-150 ft.	80	402	200
MW-12S May 30, 2013			
45-58 ft.	20	177	25
MW-13I May 31, 2013			
78-88 ft.	5	136	25
MW-13S May 31, 2013			
20-35 ft	5	204	25
E-5 May 31, 2013			
43-63 ft.	5	970	200
TOTALS		9,304	2,089

* Water used to flush permanganate from injection system

3.0 PRESSURE TRANSDUCER RESULTS

During the injections, pressure transducers were installed in selected nearby wells to record relative water-level changes.

The pressure transducer results were used to evaluate the radius of influence (ROI) associated with the injection wells. Significant changes in water level (more than a foot) were noted in monitoring wells near each injection well. Water level changes of a foot or more were considered indicative of a hydraulic connection with the injecting well. Attachment A provides charts of the pressure transducer data for each injection event. Table 2 summarizes these results.

Review of the transducer data indicates that, generally, injections in the intermediate depth intervals between 20 feet and 60 feet below ground had the most effect in terms of maximum changes in water levels (one foot or greater). These maximum water level changes could extend from approximately 100 ft to approximately 265 ft from the injection site. Deeper injection intervals (90 ft to 300 ft) had a ROI that extended from approximately 100 ft to approximately 300 ft based on only two injection events, E-2 at 90 ft to 150 ft and M-22D at 294 ft to 304 ft.

During the injection in well E-2 at 32 ft to 52 ft, water and permanganate rose out of the ground around the well casings at monitoring well MW-11D and E-2 forcing a halt to the injection.

Based on the pressure transducer results, a minimum ROI of between 100 ft and 265 ft was estimated for the injection events in the shallow to intermediate depth intervals (20 ft to 60 ft). A minimum ROI of 100 ft to 300 ft was estimated for the deeper depth intervals.

4.0 POST-INJECTION MONITORING PROGRAM

Tetra Tech will obtain groundwater samples from selected wells on a periodic basis following the Round 2 ISCO injection event. The monitoring program will help determine the effectiveness of the injections and measure the spread of the solution (both laterally and vertically). Tetra Tech assumes that samples will be collected from the monitoring wells for both chemical and physical parameter analyses.

For planning, Tetra Tech will conduct two rounds of performance monitoring after Round 2 injections. These events will occur at the end of Month 3 (August 2013) and Month 6 (November 2013). Low-flow sampling techniques will be employed for screened wells, while the team will purge one volume of groundwater from open borehole wells. If the permanganate ion (MnO_4^-) is present in a particular monitoring well, samples will generally not be taken from that well. If necessary, samples containing the presence of permanganate will be preserved using ascorbic acid in accordance with EPA/600/R-12/049 *Groundwater Sample Preservation at In-Situ Chemical Oxidation Sites - Recommended Guidelines* (EPA, 2012).

TABLE 2
SUMMARY OF PRESSURE TRANSDUCER RESULTS MAY 20 - 31, 2013
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA
PAGE 1 OF 2

Monitored Depth Interval	E-1 20-40'*		E-2 32-52'*				E-3 40-60'*		E-4 30-50'*		E-5 43-63'*		E-6 95-115'*		E-7 18-38'*		E-8 40-60'*	
	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ
E-3 (19-150')	265	0.7	390	0.4	<0.01	0.05	---	0	----	195	1.4	330	----	70	----	398	0.6	0.4
E-4 (19-150')	150	0.7	195	0.03	<0.01	<0.01	---	195	----	0	---	383	----	150	----	203	0.2	0.8
E-6 ((19-150')	270	<0.01	330	0.01	<0.01	0.02	---	75	----	150	----	285	----	0	----	535	0.02	0.03
E-7 (19-100')	173	2.4	135	---	---	---	---	398	----	195	---	540	----	353	----	0	---	--
E-8 (19-120')	420	---	203	---	---	0.2	420	0.01	300	0.01	315	0.02	345	<0.01	345	<0.01	0.02	
E-9 (30-100')	353	---	353	---	---	---	135	---	218	---	195	---	90	---	405	---	---	
MW-21 (70-80')	668	---	615	---	---	0.04	420	0.05	533	---	165	1.3	405	---	705	---	---	
MW-25 (44-54')	668	---	615	---	---	0.07	420	0.02	533	---	165	1	405	---	705	---	---	
MW-06I (88-98')	255	0.1	360	0.03	<0.01	0.04	0.01	540	0.1	375	0.11	750	0.02	593	0.02	225	0.07	0.1
MW-06S (24-34')	255	0.2	360	<0.01	<0.01	0.02	0.01	540	0.02	375	0.12	750	<0.01	593	0.03	225	0.02	0.3
MW-10B (65-75')	38	0.8	240	<0.01	<0.01	0.04	0.9	315	0.7	155	0.82	540	0.02	293	0.31	135	0.6	1.4
MW-10C (104-114')	30	0.2	248	<0.01	<0.01	0.02	0.6	300	0.4	165	0.41	533	0.03	285	0.06	150	0.1	0.34
MW-12I (88-98')	255	0.2	386	0.03	<0.01	0.01	0.3	50	1.4	195	0.63	375	0.1	98	0.06	390	0.2	0.2
MW-12S (45-58')	255	0.9	386	0.01	<0.01	0.05	---	50	---	195	0.56	375	---	98	0.02	390	<0.01	0.3
MW-13D (122-132')	510	---	518	---	<0.01	---	0.1	240	0.5	380	---	180	0.3	225	0.04	570	---	---
MW-13S (20-35')	510	---	518	---	---	---	240	<0.01	380	---	180	---	225	0.01	570	---	---	
MW-14S (35-50')	488	---	285	---	---	---	435	---	353	---	255	1.1	360	---	413	---	---	
MW-15I (90-105')	203	0.7	98	0.03	<0.01	0.02	3.7	398	0.7	195	1.4	518	0.01	353	0.02	45	0.4	1.2
MW-15S (48-58')	203	0.5	98	0.01	<0.01	0.3	0.9	398	0.12	195	0.7	518	0.04	353	0.03	45	0.4	1.8
MW-16S (30-45')	210	---	450	---	---	0.02	225	0.38	265	0.08	555	0.04	270	0.04	368	---	---	
MW-18S (14-36')	270	0.4	338	<0.01	<0.01	0.1	---	68	---	143	0.06	360	---	75	---	330	0.3	0.4
MW-28I (55-65')	143	2.9	120	---	<0.01	0.01	0.7	293	0.86	113	6.4	443	0.03	255	0.01	105	0.9	3.3
MW-28S (35-45')	150	4.4	113	---	<0.01	0.04	---	300	---	108	7.1	443	---	255	---	105	0.07	8.6

Note:

* Injection Depth Interval

Maximum Δ - maximum change in water level (increase or decrease) in feet, per injection interval per injection event

--- Indicates that a transducer was not used

dist. Distance from injection well to monitoring well, in feet

Indicates a water level change (increase or decrease) greater than 1 foot

TABLE 2
SUMMARY OF PRESSURE TRANSDUCER RESULTS MAY 20 - 31, 2013
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA
PAGE 2 OF 2

Monitored Depth Interval	E-9 30-40'*		MW-10A 36-46'*		MW-11S 44-54'*		MW-12S 45-58'*		MW-13I 78-88'*		MW-13S 20-35'*		MW-18S 16-36'*		MW-22D 294-304'*		MW-28S 36-45'*	
	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ	dist.	Maximum Δ
E-3 (19-150')	135	----	323	0.5	375	---	45	----	240	----	240	----	60	0.68	30	0.3	300	0.2
E-4 (19-150')	218	----	158	0.07	210	0.02	188	----	375	----	375	----	135	----	225	----	105	----
E-6 ((19-150')	90	----	300	<0.01	315	<0.01	100	----	225	----	225	----	75	----	75	----	255	----
E-7 (19-100')	405	----	120	1	210	---	375	----	570	----	570	----	330	----	420	----	105	----
E-8 (19-120')	323	0.01	398	----	128	0.03	450	0.02	450	<0.01	450	<0.01	390	0.01	420	0.01	285	0.01
E-9 (30-100')	0	---	375	----	315	----	180	---	165	----	165	----	165	----	120	----	300	----
MW-21 (70-80')	323	---	690	----	555	----	480	0.03	195	---	195	0.27	480	---	390	---	600	---
MW-25 (44-54')	323	---	690	----	555	----	480	0.1	195	0.25	195	0.2	480	---	390	---	600	---
MW-06I (88-98')	600	0.01	225	0.2	435	----	510	0.03	750	0.01	750	<0.01	465	0.02	570	0.06	315	0.04
MW-06S (24-34')	600	0.01	225	0.04	435	----	510	0.02	750	<0.01	750	0.01	465	0.01	570	0.03	315	0.1
MW-10B (65-75')	368	0.06	1	1.8	285	0.01	285	0.3	525	0.03	525	0.02	255	0.2	345	0.3	270	0.5
MW-10C (104-114')	363	0.02	5	0.7	290	0.02	280	0.08	520	0.06	520	0.05	250	0.06	340	0.2	275	0.1
MW-12I (88-98')	315	0.5	300	0.4	390	----	1	0.49	285	0.2	285	0.08	45	0.03	75	0.09	285	0.1
MW-12S (45-58')	315	0.5	300	0.3	390	----	0	---	285	----	285	----	45	0.04	75	0.05	285	0.2
MW-13D (122-132')	165	0.04	522	----	458	----	285	0.17	1	0.4	1	0.2	285	----	210	----	465	----
MW-13S (20-35')	165	0.2	522	----	458	----	285	0.01	0	---	0	---	285	----	210	----	465	----
MW-14S (35-50')	315	---	472	---	210	----	465	---	420	0.1	420	0.1	420	---	435	---	345	---
MW-15I (90-105')	398	0.1	150	1.9	173	0.08	390	0.07	555	0.01	555	0.01	345	0.3	420	0.5	105	0.7
MW-15S (48-58')	398	0.1	150	0.09	173	0.4	390	0.08	555	0.01	555	0.01	345	0.2	420	0.3	105	0.9
MW-16S (30-45')	375	<0.01	260	---	473	---	180	0.09	465	0.02	465	0.03	195	0.02	255	0.04	315	<0.01
MW-18S (14-36')	165	---	255	0.5	330	0.2	45	---	300	---	300	0	0	---	100	0.2	255	---
MW-28I (55-65')	304	0.2	120	0.03	158	0.2	135	0.13	465	0.01	465	0.02	240	3	315	1.5	1	5.9
MW-28S (35-45')	304	---	120	2	158	0.2	135	---	465	---	465	---	240	---	315	0.8	0	---

Note:

* Injection Depth Interval

Maximum Δ - maximum change in water level (increase or decrease) in feet, per injection interval per injection event

--- Indicates that a transducer was not used

dist. Distance from injection well to monitoring well, in feet

 Indicates a water level change (increase or decrease) greater than 1 foot

For each round of performance monitoring, samples will be collected from up to 22 wells. Samples will be analyzed for TCL VOCs using CLP Method SOM01.1 for each round. Table 3 provides the proposed list of wells. Tetra Tech assumes that these performance monitoring events will 1 week per event (plus mobilization/demobilization and administrative support), and will not include the sampling of no more than two open borehole wells per event. A three-person team will perform the work.

After Round 2 injections, Tetra Tech will evaluate if monitoring wells near injection wells are affected by the oxidant solution based on the presence of permanganate's purple color in well water along with elevated manganese concentrations and ORP readings (referred to as process monitoring). Samples will not be collected for fixed-base laboratory analyses. The post-injection process monitoring events will occur up to four times. These events will occur during Month 1 (June 2013), Month 2 (July 2013), Month 4 (September 2013), and Month 7 (December 2013). Tetra Tech assumes that these process monitoring events may involve up to 28 wells each time, and will last approximately 2 days per event (including mobilization, equipment rentals, travel, and reporting). A two-person field team will perform the work.

Tetra Tech assumes that the total number of groundwater sampling events that will be performed under the WA may be conducted according to a different timeline or interval. For example, it may be necessary to carry out five process monitoring events after the Round 2 ISCO injections, but only three such events after subsequent injections (e.g., Rounds 3 and 4). This flexibility should be considered part of the WA SOW, assuming the overall number of groundwater sampling events does not change.

5.0 LESSONS LEARNED

The following is a list of lessons learned from the second round of ISCO injections:

1. Several of the low-pressure hoses failed during injections at the site. For future injection activities, all injections hoses shall tested and certified to meet expected injection pressures as specified in the scope of work. Certification of the hoses shall be supplied to Tetra Tech prior to site activities.
2. Spill containment pads shall be installed under or around any permanganate transfer hoses/piping which may need to be disconnected during injection activities. Mortar tubs/Kiddie pools where available onsite and were supplied to the subcontractor for use as spill containment pads to prevent spills to the ground surface.

TABLE 3
POST-INJECTION MONITORING PROGRAM
VALMONT TCE SITE
LUZERNE COUNTY, PENNSYLVANIA

WELL	PROCESS	PERFORMANCE⁽²⁾	COMMENTS⁽¹⁾
E-1	▲	▲	Round 2 Injection Well
E-2	▲	▲	Round 2 Injection Well
E-3	▲	▲	Round 2 Injection Well
E-4	▲	▲	Round 2 Injection Well
E-5	▲	▲	Round 2 Injection Well
E-6	▲	▲	Round 2 Injection Well
E-7	▲	▲	Round 2 Injection Well
E-8	--	▲	
E-9	▲	▲	Round 2 Injection Well
2S	▲	▲	
2I	▲	--	
6S	▲	▲	
6I	▲	▲	
10A	▲	▲	Round 2 Injection Well
10B	▲	--	
10C	▲	▲	
11S	▲	▲	Round 2 Injection Well
11D	▲	▲	Round 2 Injection Well
12S	▲	▲	Round 2 Injection Well
12I	▲	--	
13S	▲	▲	Round 2 Injection Well
13I	▲	--	Round 2 Injection Well
15S	▲	--	
15D	▲	--	
18S	▲	▲	Round 2 Injection Well
22D	▲	▲	Round 2 Injection Well
28S	▲	▲	Round 2 Injection Well
28I	▲	--	
GW-21	--	▲	
GW-9	▲	▲	
TOTALS	28	23	Plus QA/QC samples

⁽¹⁾ Selected wells containing the presence of permanganate during monitoring may be sampled at the direction of EPA.

⁽²⁾ All performance samples will be analyzed for VOCs. Selected comprehensive monitoring samples may be analyzed for total and dissolved metals.

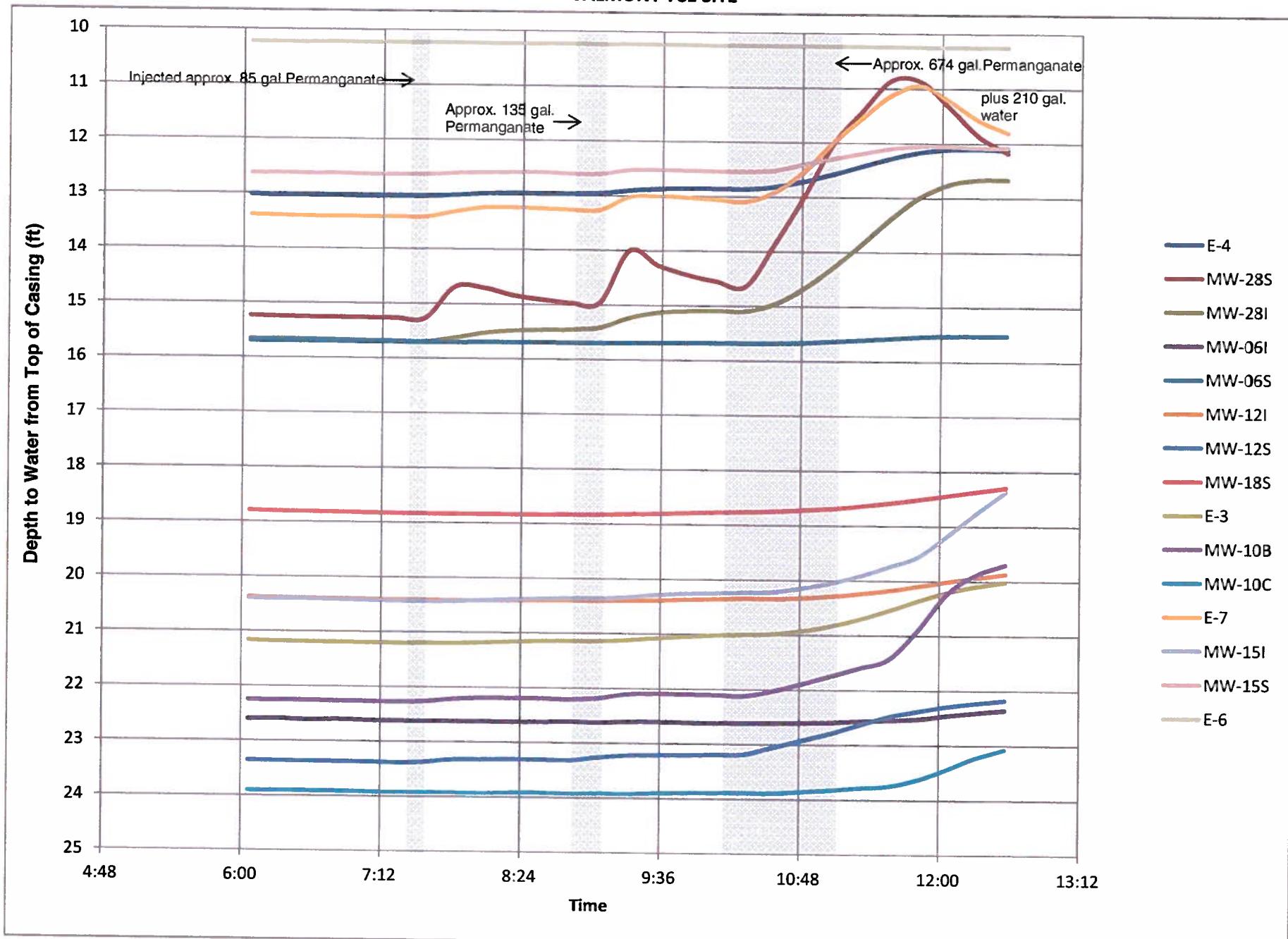
3. Several proposed injection well intervals were not suitable for the low-pressure (up to 125 psi) injections. Injections at these wells/zones were not successful. In the future, optional injection zones/intervals will be selected and listed within the work plans and or scope of work. This will help with decision making and save time in the field.
4. Portable lighting must be made available for any work conducted inside the former Chromatex building. The majority of the building lights are currently non-operational and the areas around wells MW-18 and E-6 are very dark. Tetra Tech personnel purchased several portable light stands for use by the subcontractor during indoor injection activities.

ATTACHMENT A

E-1 INJECTION (20 FT - 40 FT ZONE)

MAY 21, 2013

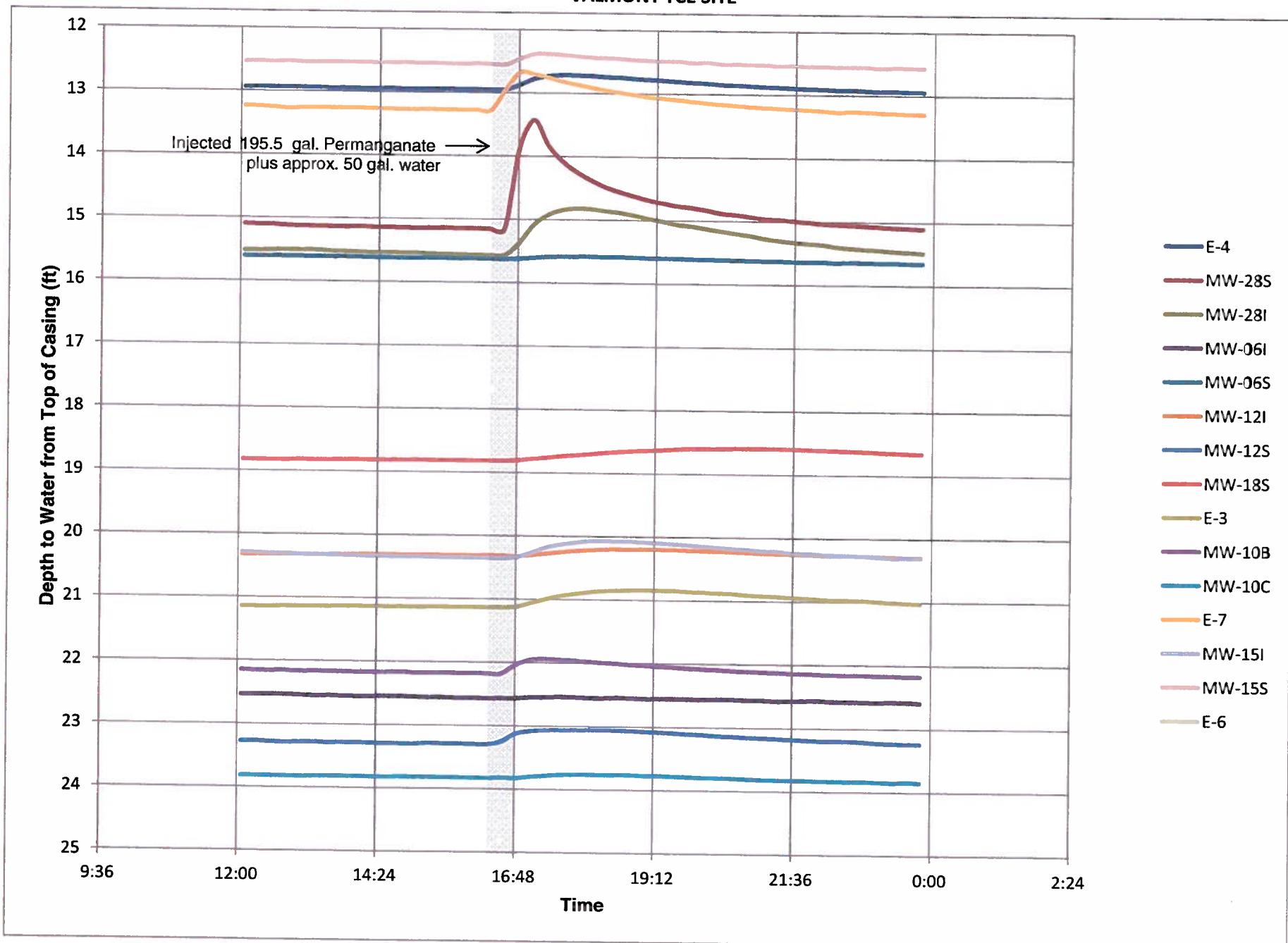
VALMONT TCE SITE



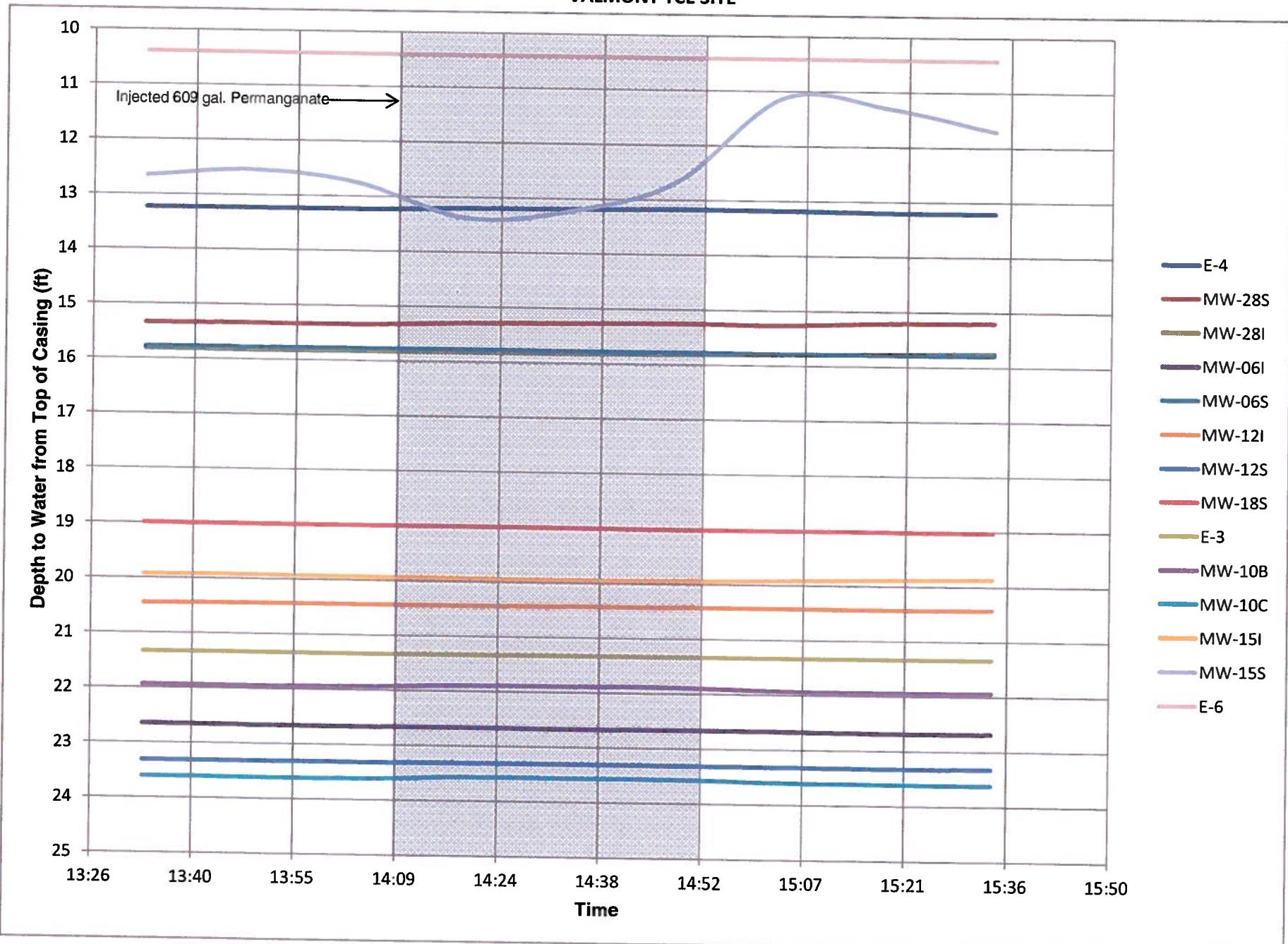
E-1 INJECTION (20 FT - 40 FT ZONE)

MAY 20, 2013

VALMONT TCE SITE



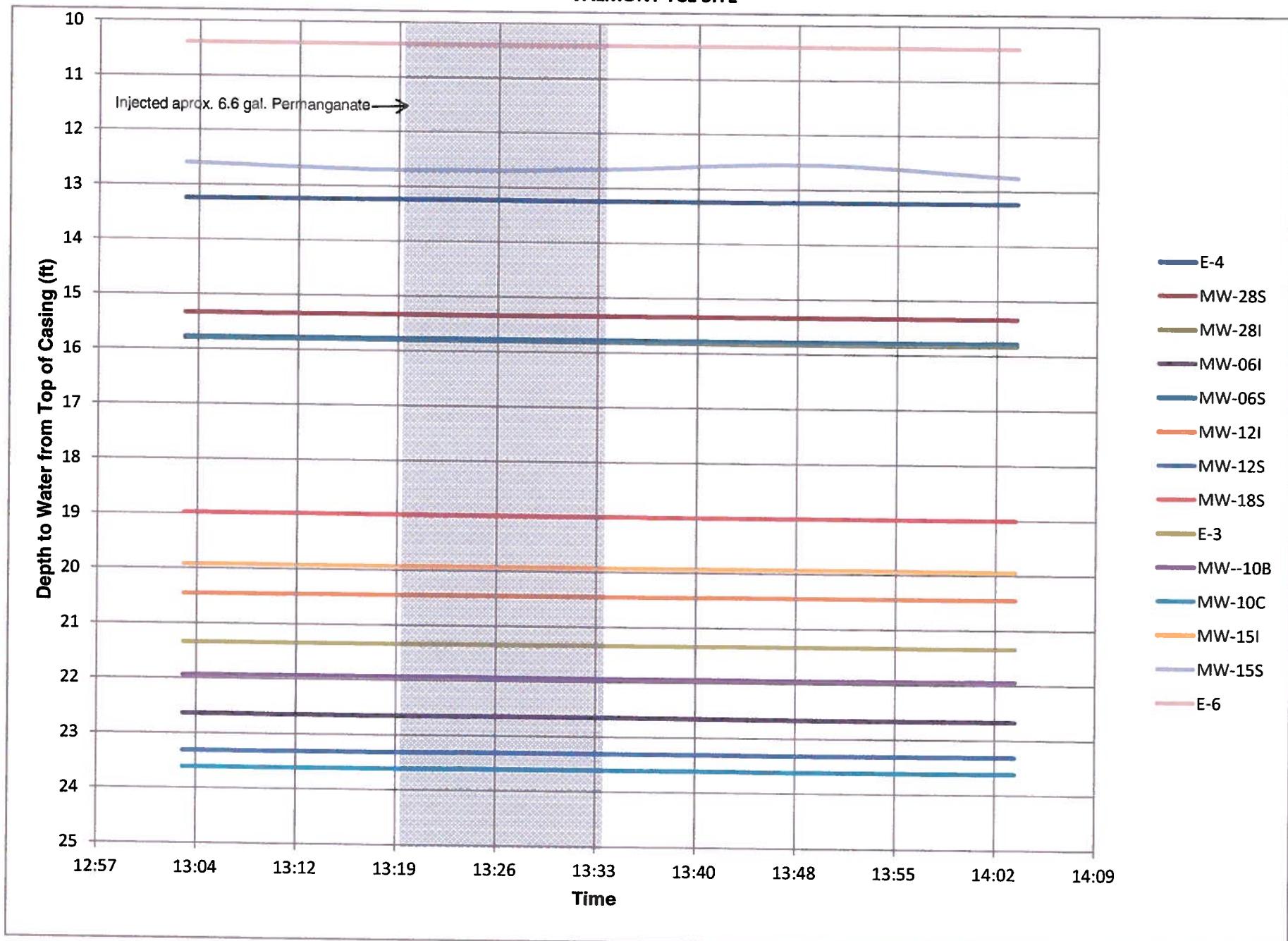
E-2 INJECTION (32 FT-52 FT ZONE)
MAY 22, 2013
VALMONT TCE SITE



E-2 INJECTION (70 FT- 90 FT ZONE)

MAY 22, 2013

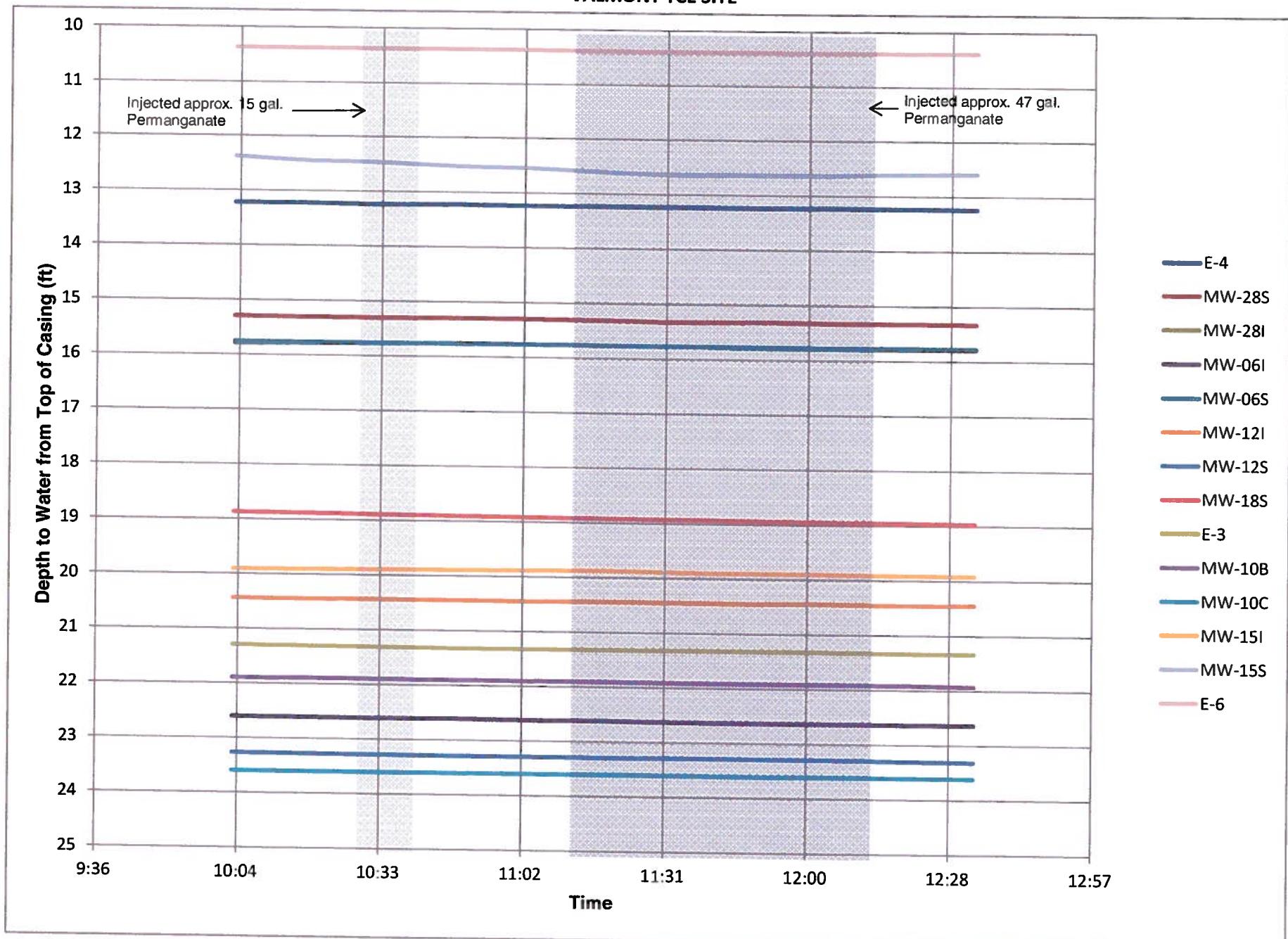
VALMONT TCE SITE



E-2 INJECTION (90 FT-110 FT ZONE)

MAY 22, 2013

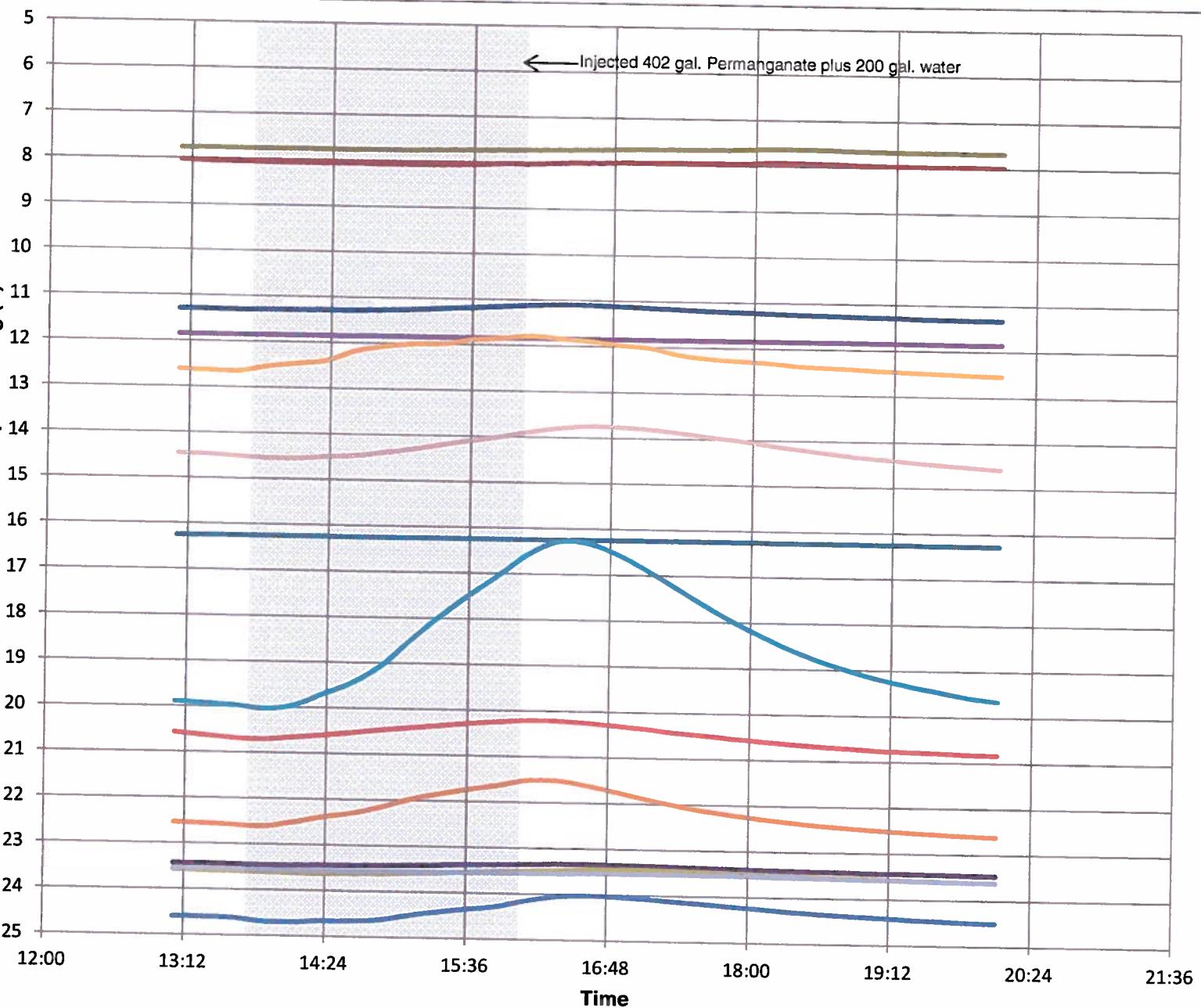
VALMONT TCE SITE



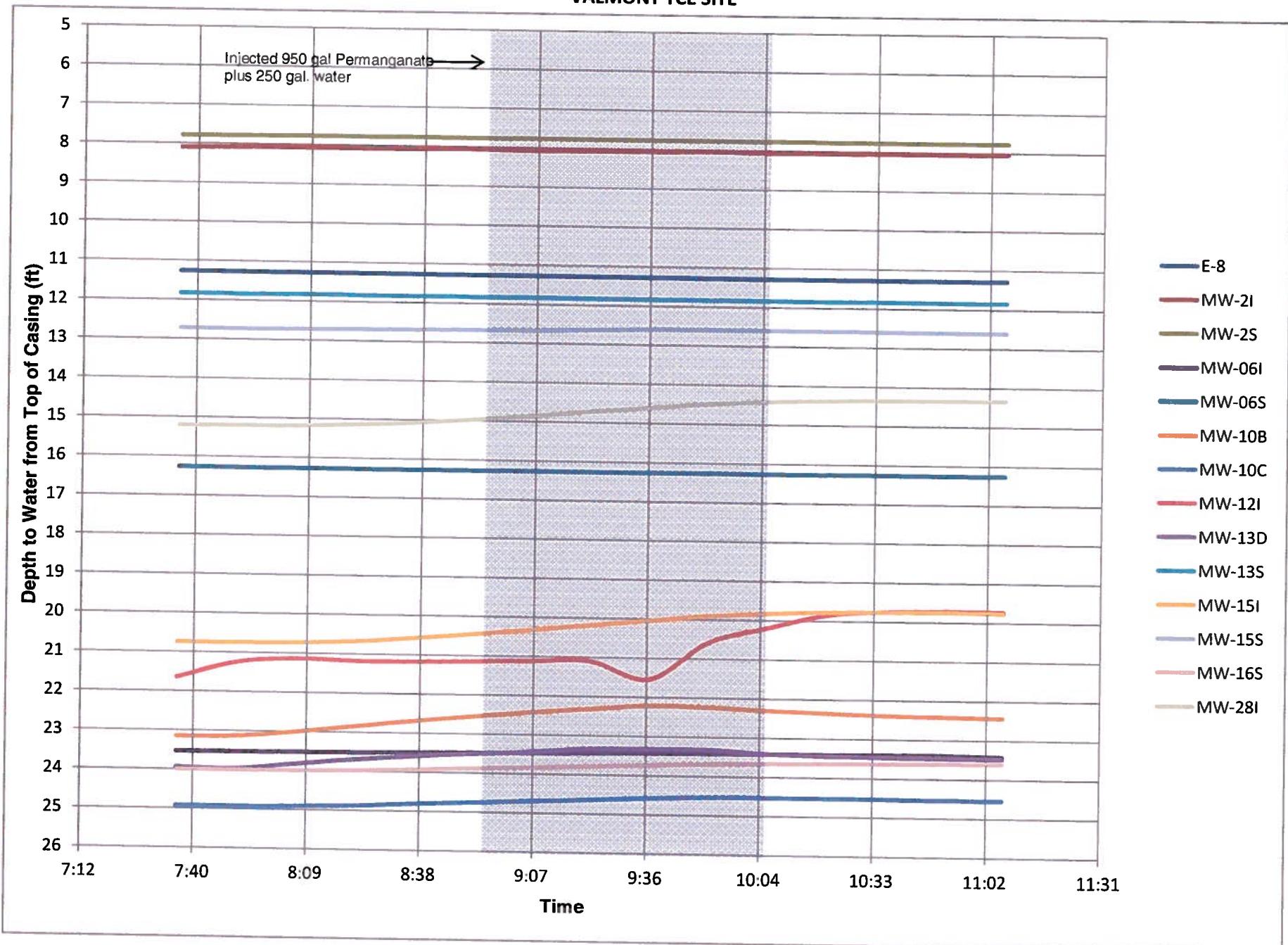
E-2 INJECTION (90 FT- 150 FT ZONE)

MAY 30, 2013

VALMONT TCE SITE



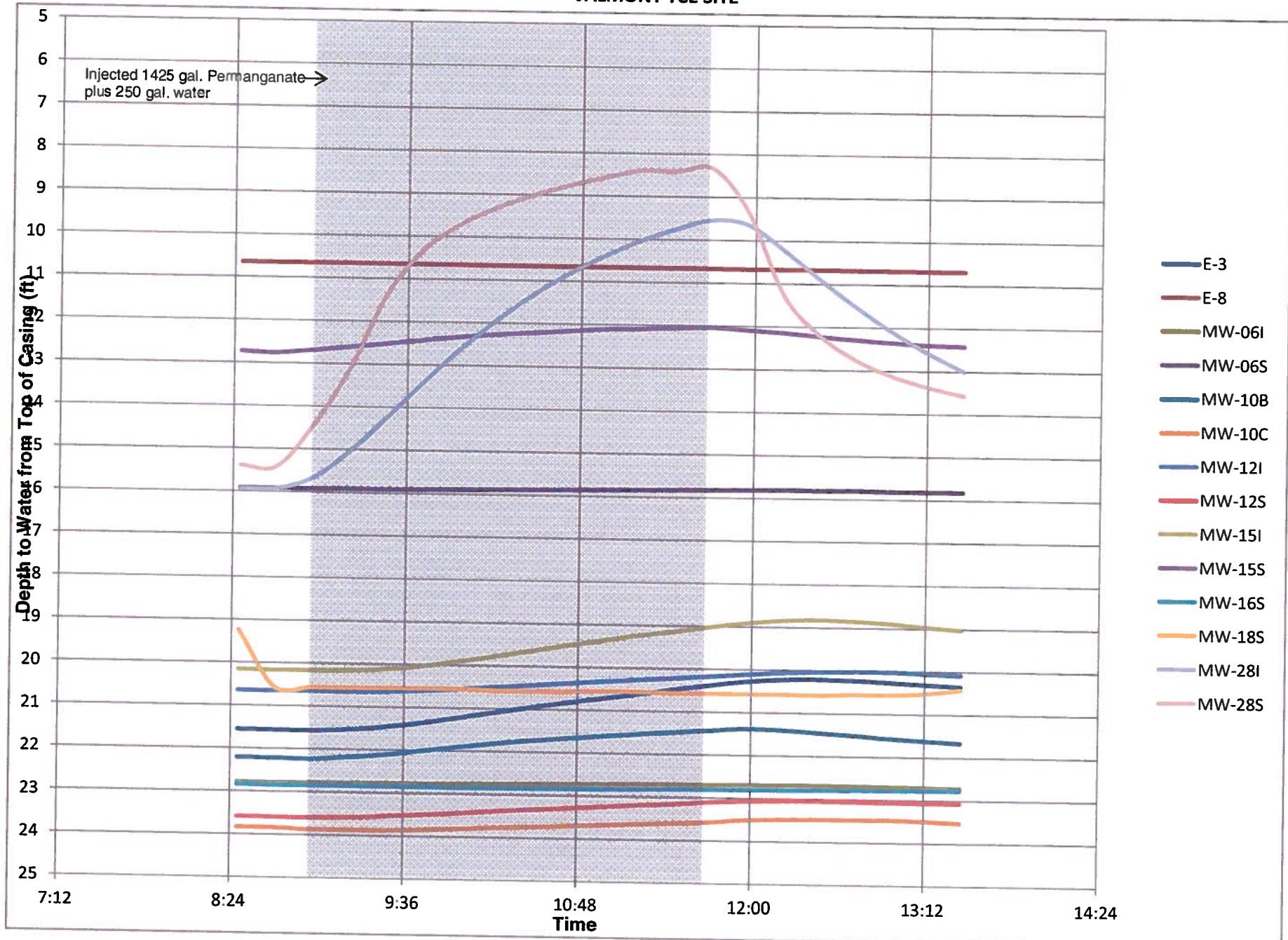
E-3 INJECTION (40 FT- 60 FT ZONE)
MAY 30, 2013
VALMONT TCE SITE



E-4 INJECTION (30 FT-50 FT ZONE)

MAY 23, 2013

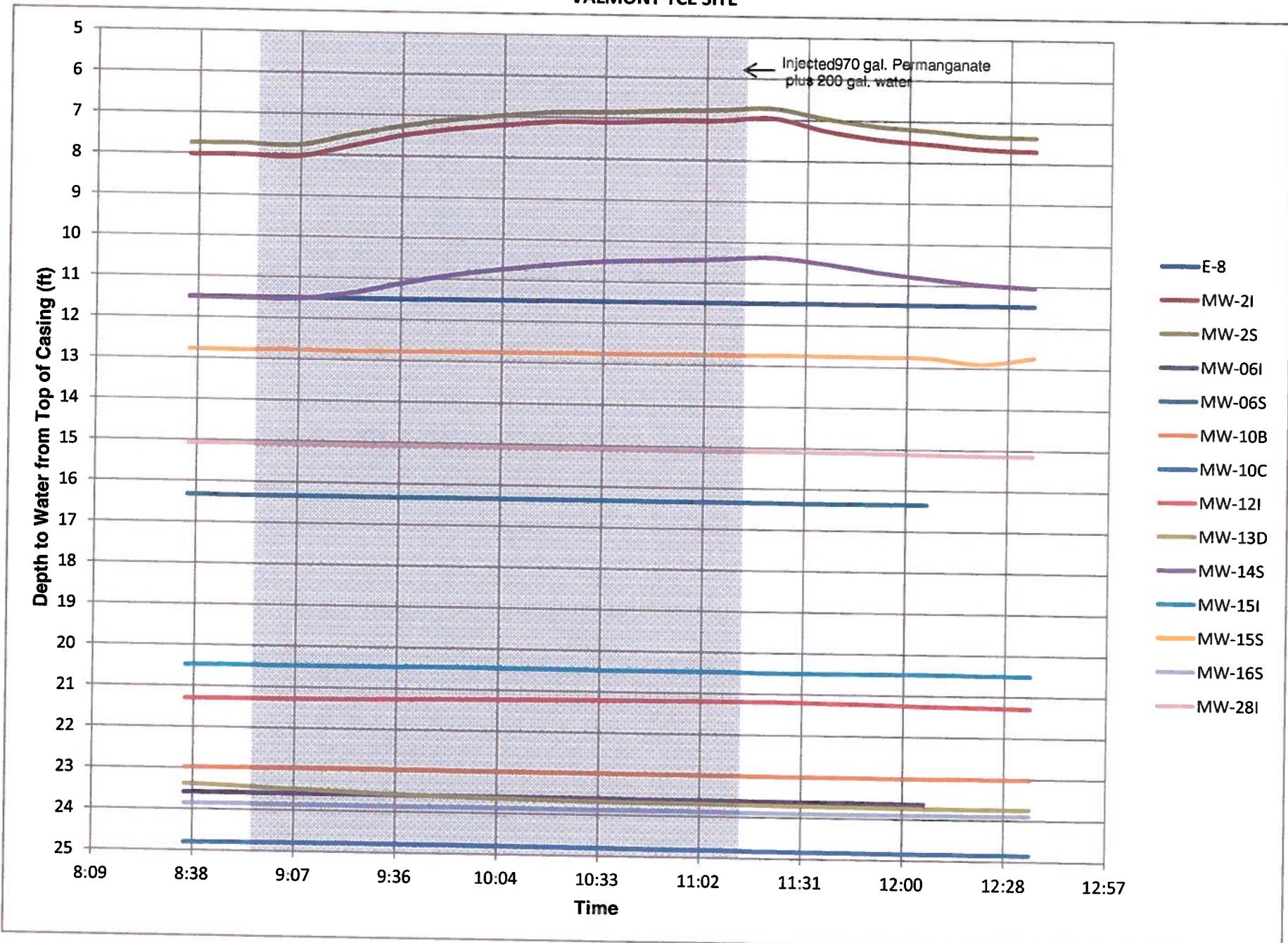
VALMONT TCE SITE



E-5 INJECTION (43 FT- 63 FT ZONE)

MAY 31, 2013

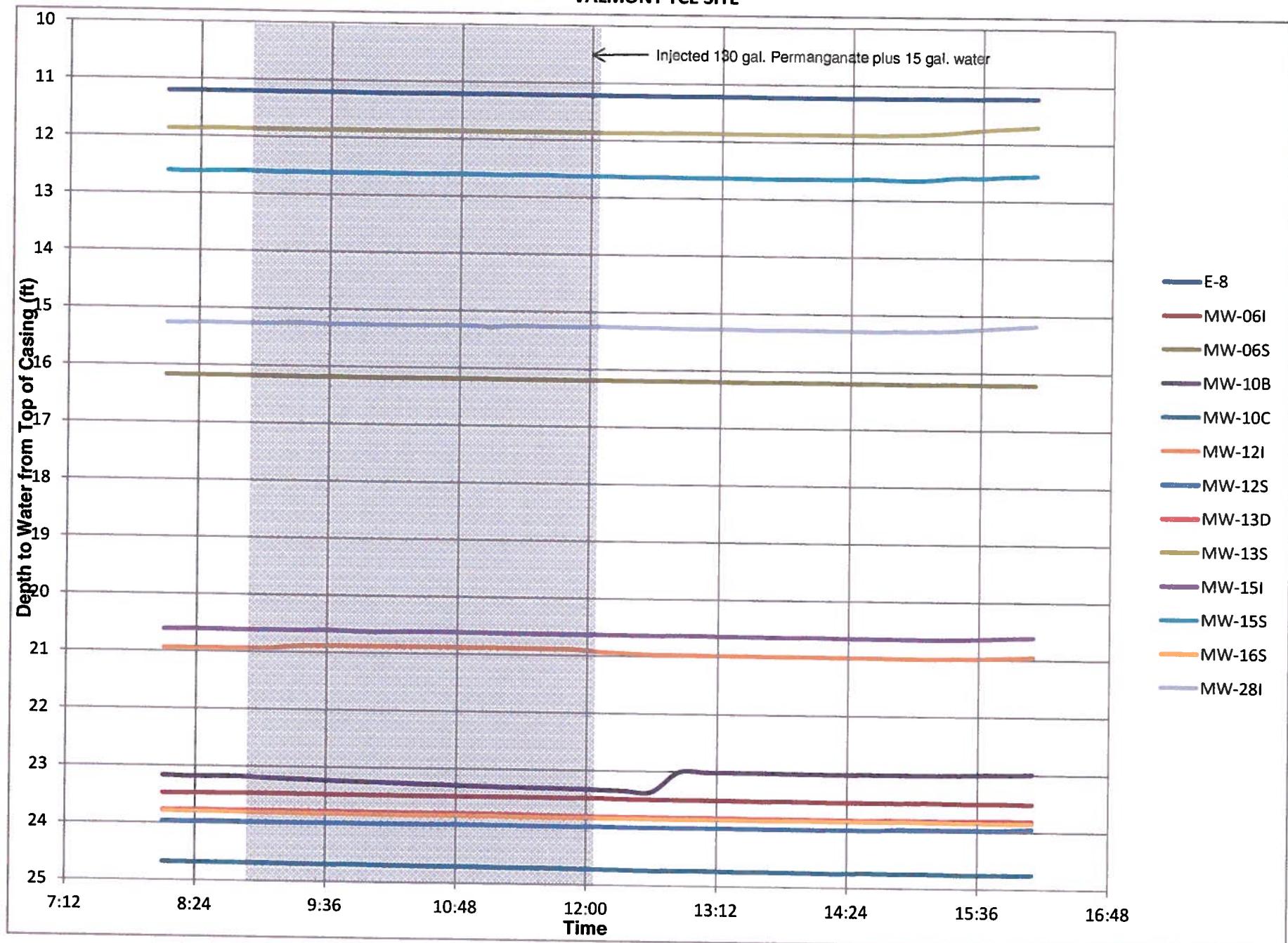
VALMONT TCE SITE



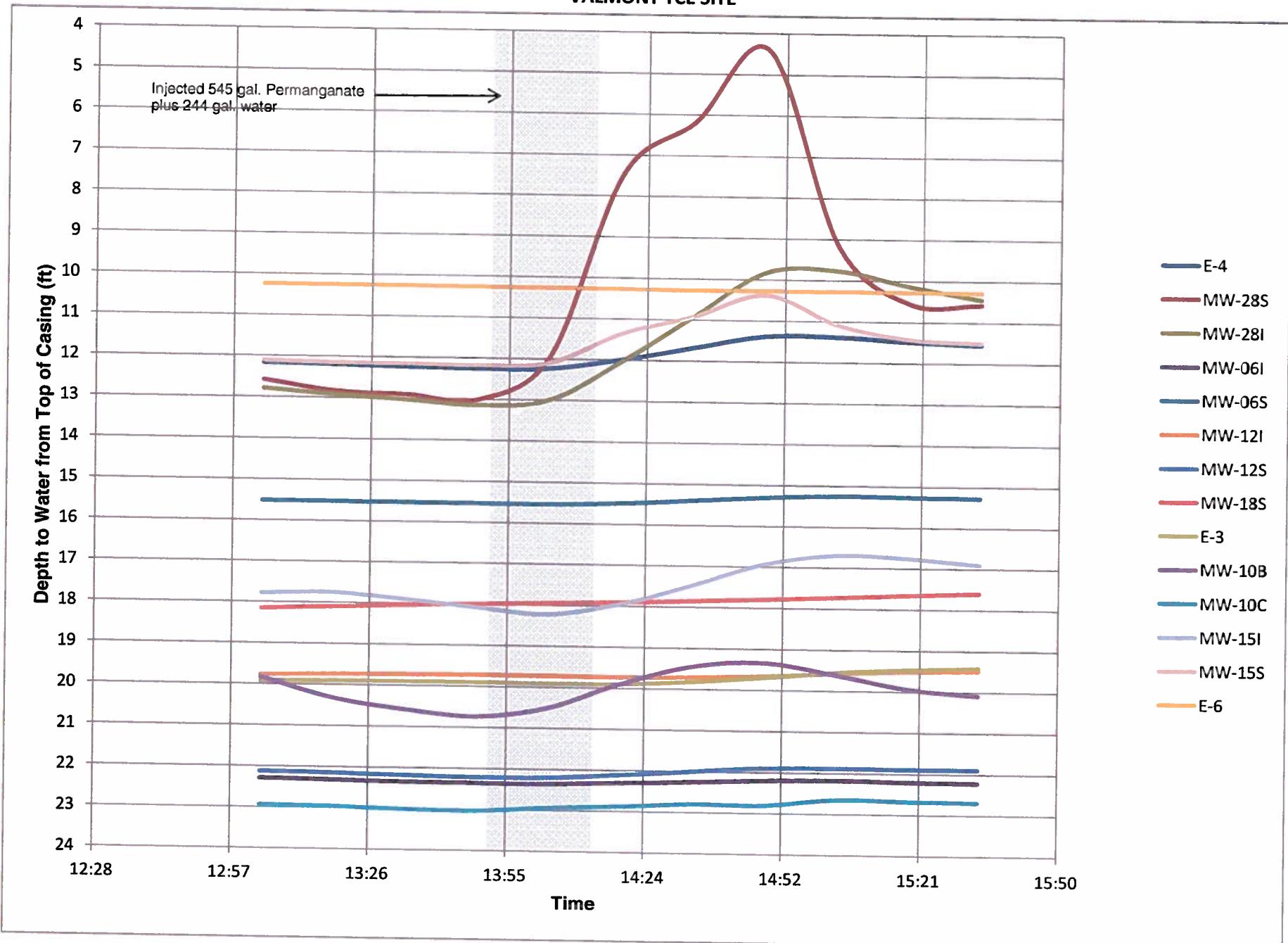
E-6 INJECTION (95 FT- 115 FT ZONE)

MAY 29, 2013

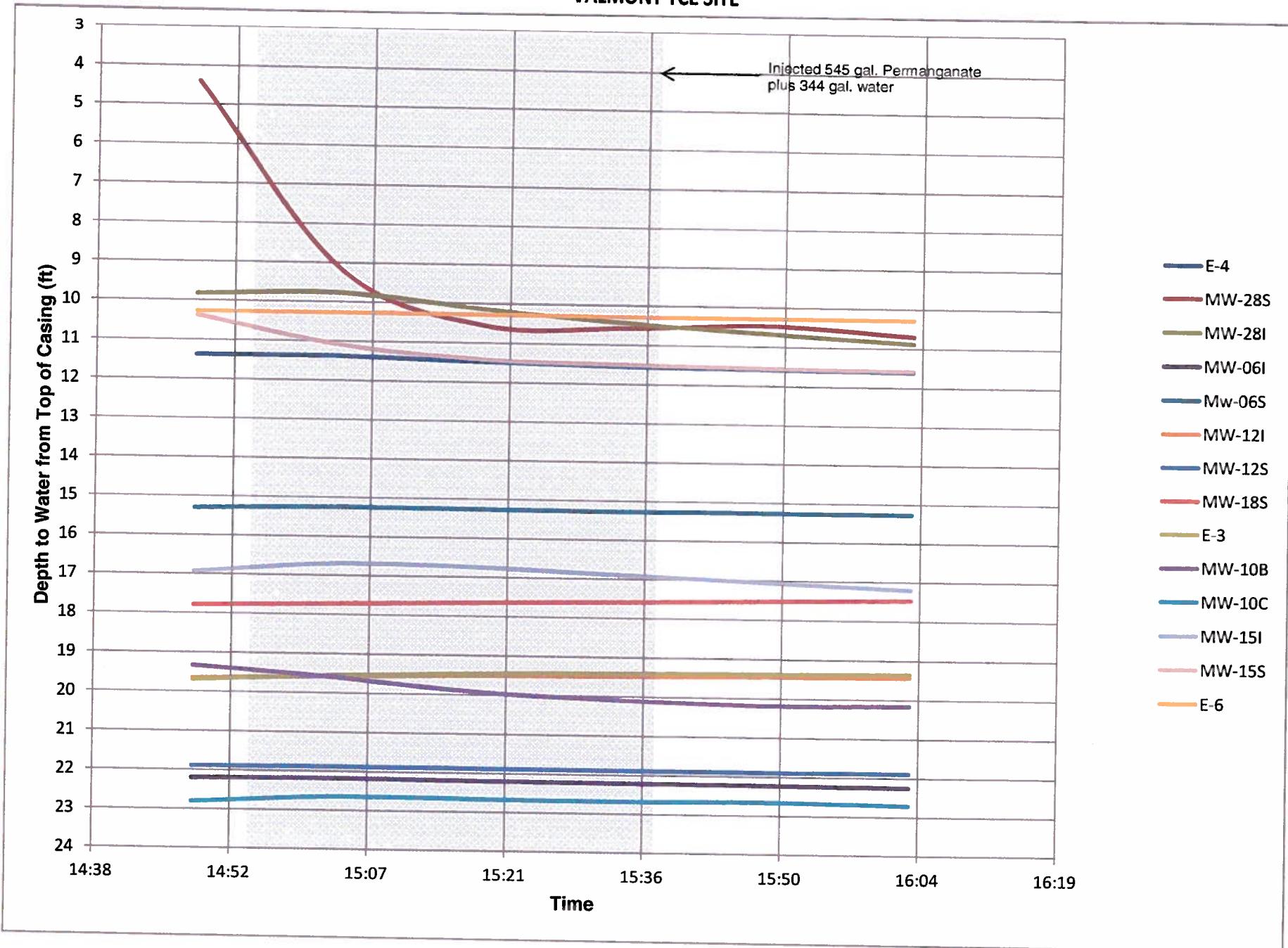
VALMONT TCE SITE



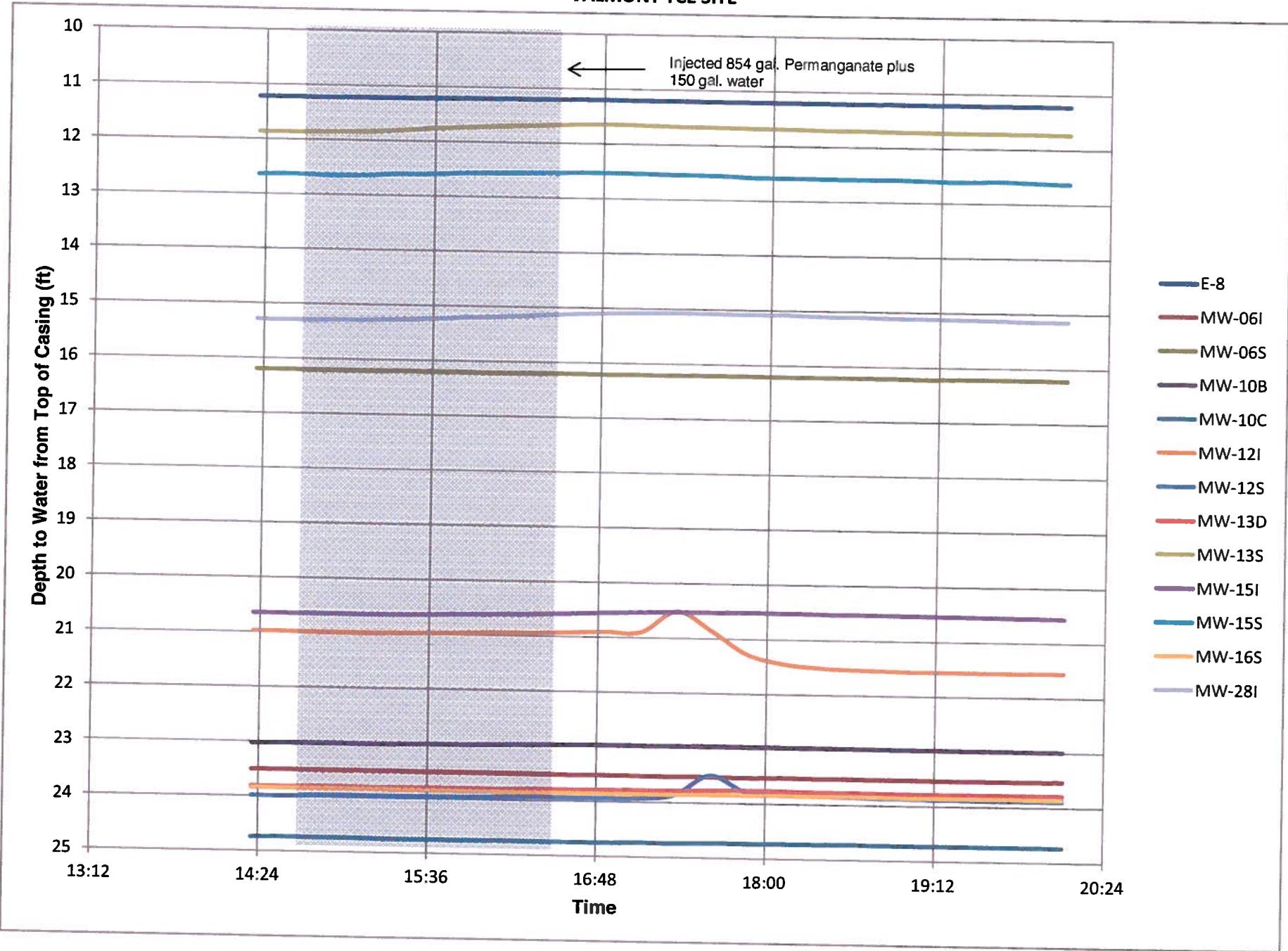
**E-7 INJECTION (40 FT- 60 FT ZONE)
MAY 21, 2013
VALMONT TCE SITE**



**E-7 INJECTION (18 FT- 38 FT ZONE)
MAY 21, 2013
VALMONT TCE SITE**



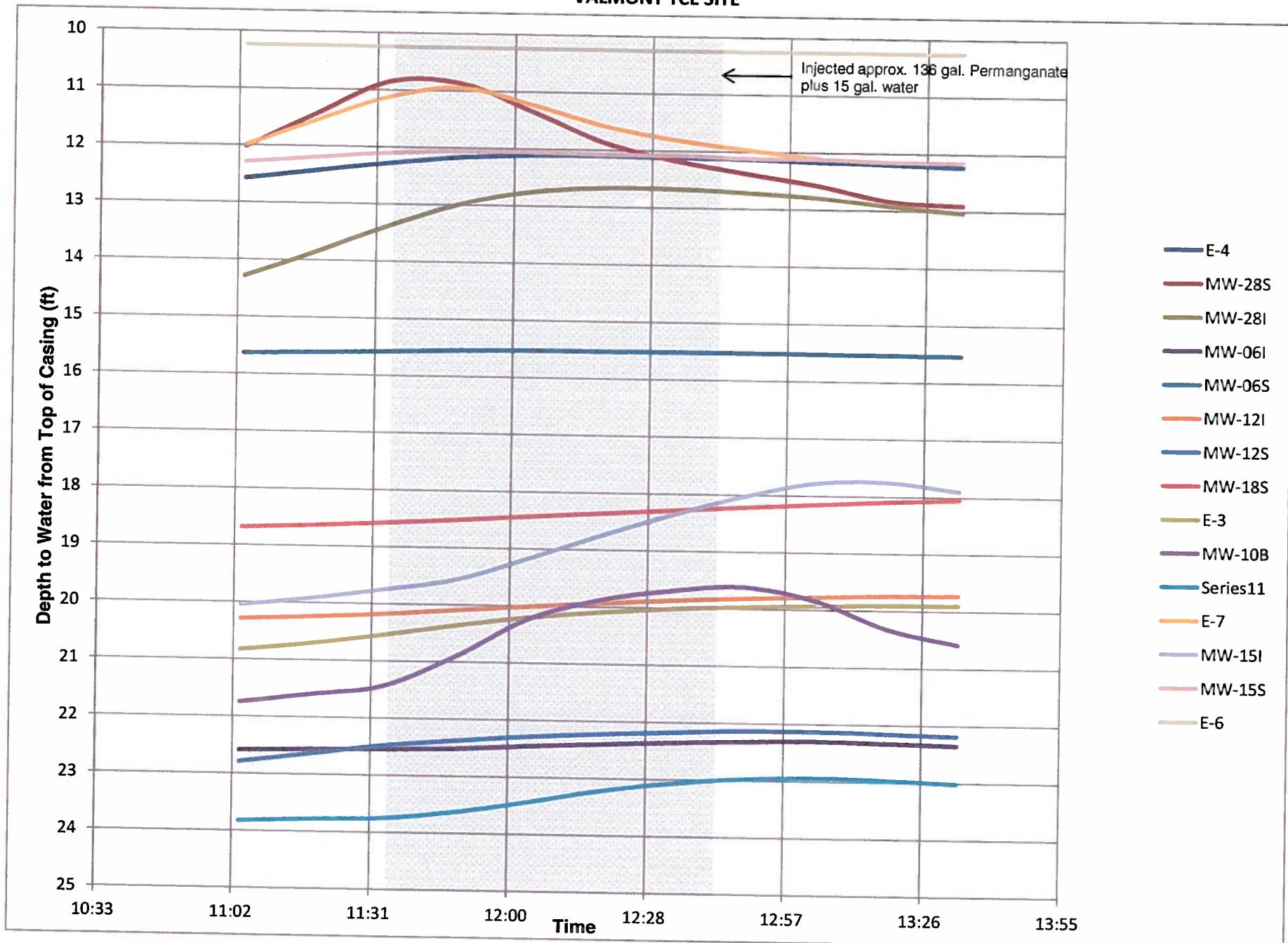
**E-9 INJECTION (30 FT- 40 FT ZONE)
MAY 29, 2013
VALMONT TCE SITE**



MW-10A INJECTION (36 FT - 46 FT ZONE)

MAY 21, 2013

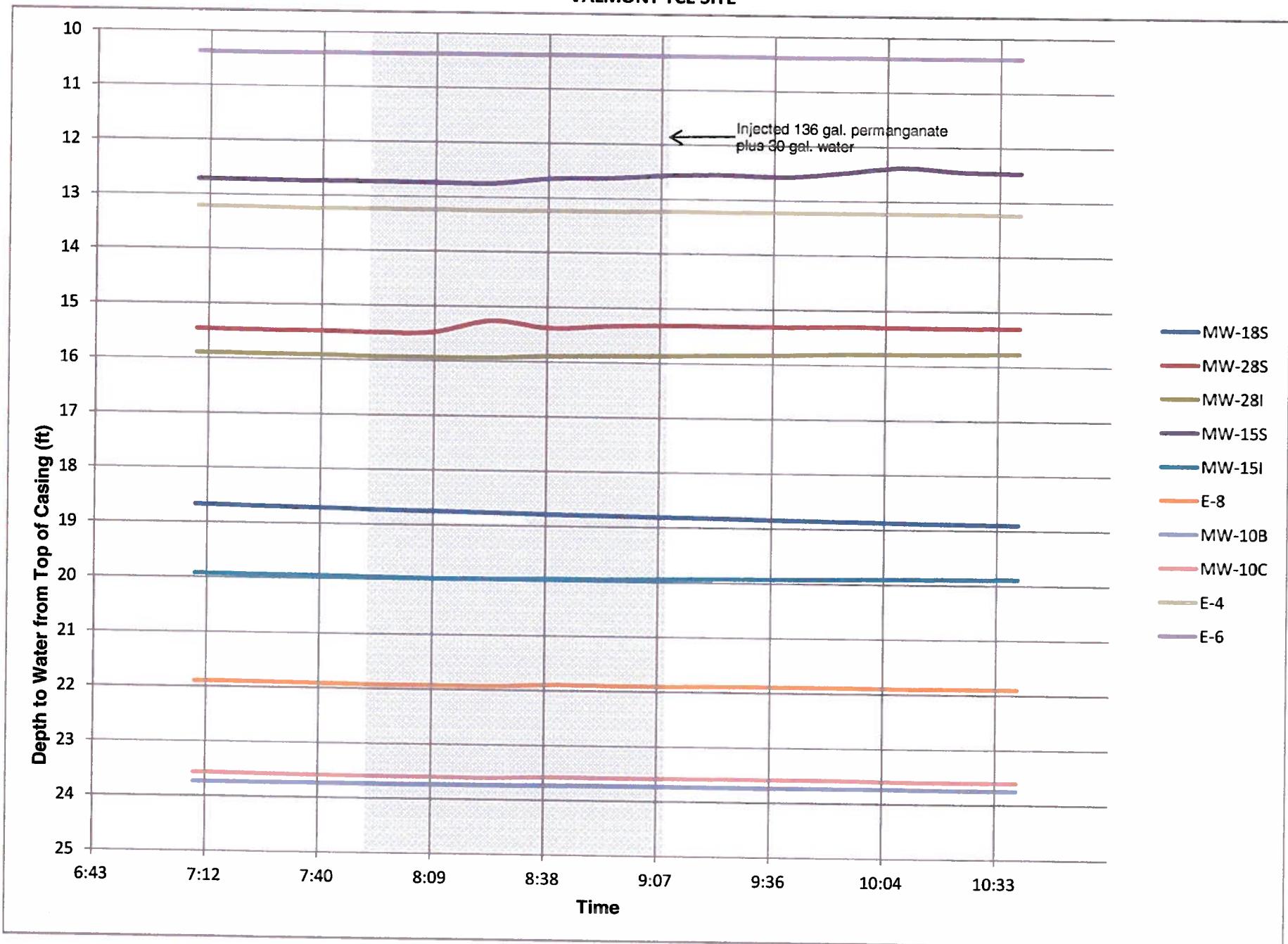
VALMONT TCE SITE



MW-11S INJECTION (44 FT- 54 FT ZONE)

MAY 22, 2013

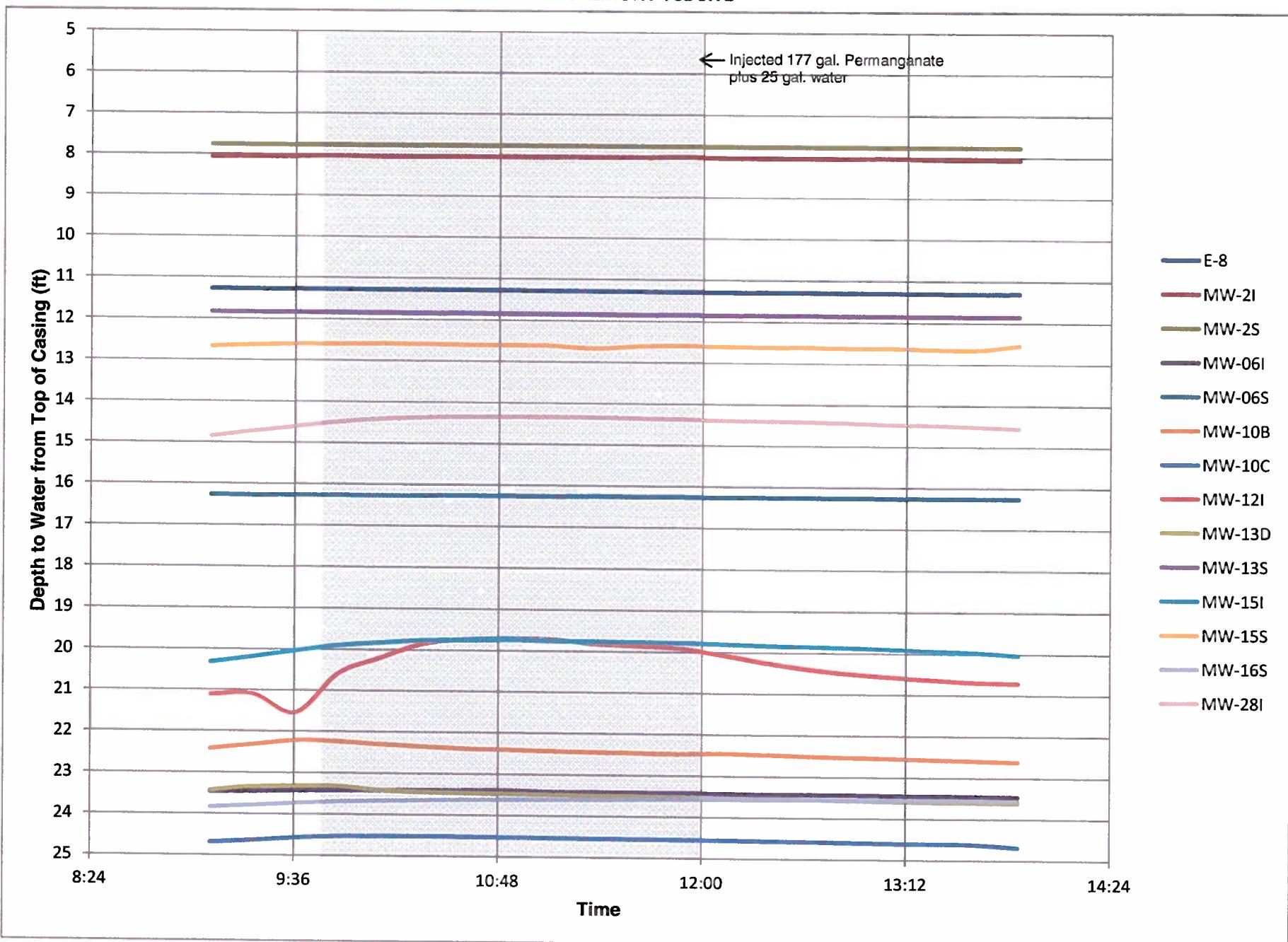
VALMONT TCE SITE



MW-12S INJECTION (45 FT - 58 FT ZONE)

MAY 30, 2013

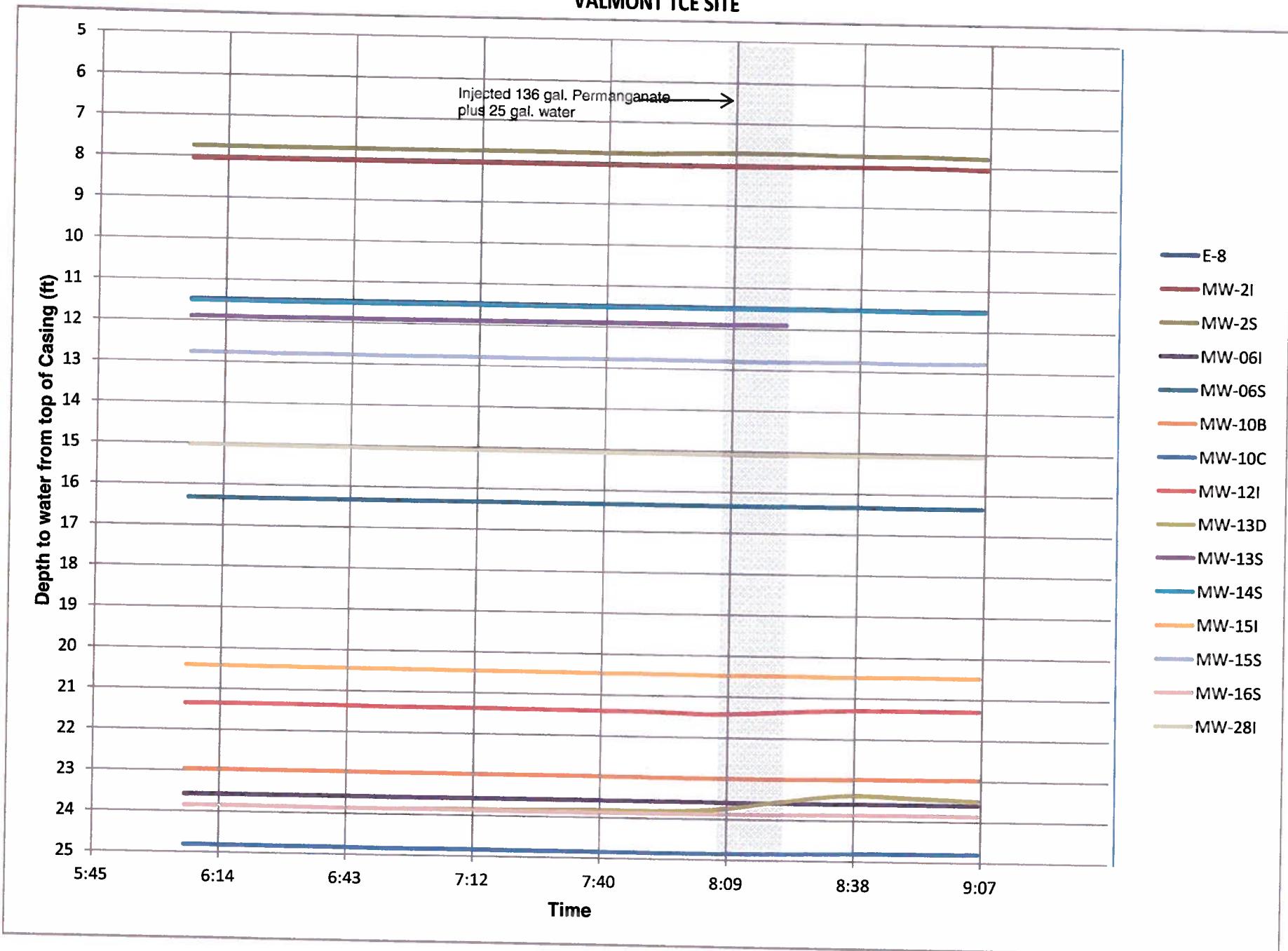
VALMONT TCE SITE



MW-13I INJECTION (78 FT- 88 FT ZONE)

MAY 31, 2013

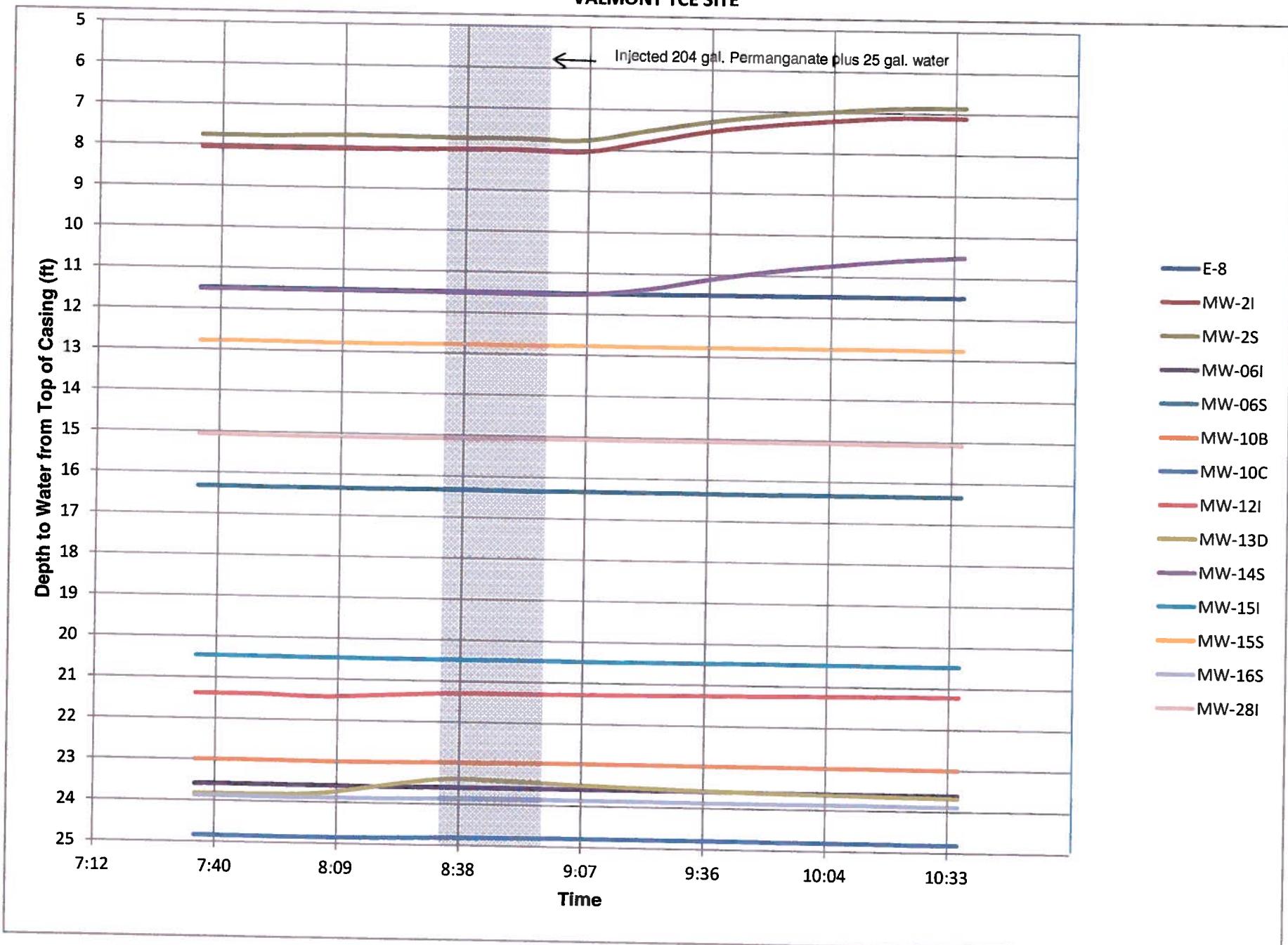
VALMONT TCE SITE



MW-13S INJECTION (20 FT- 35 FT ZONE)

MAY 31, 2013

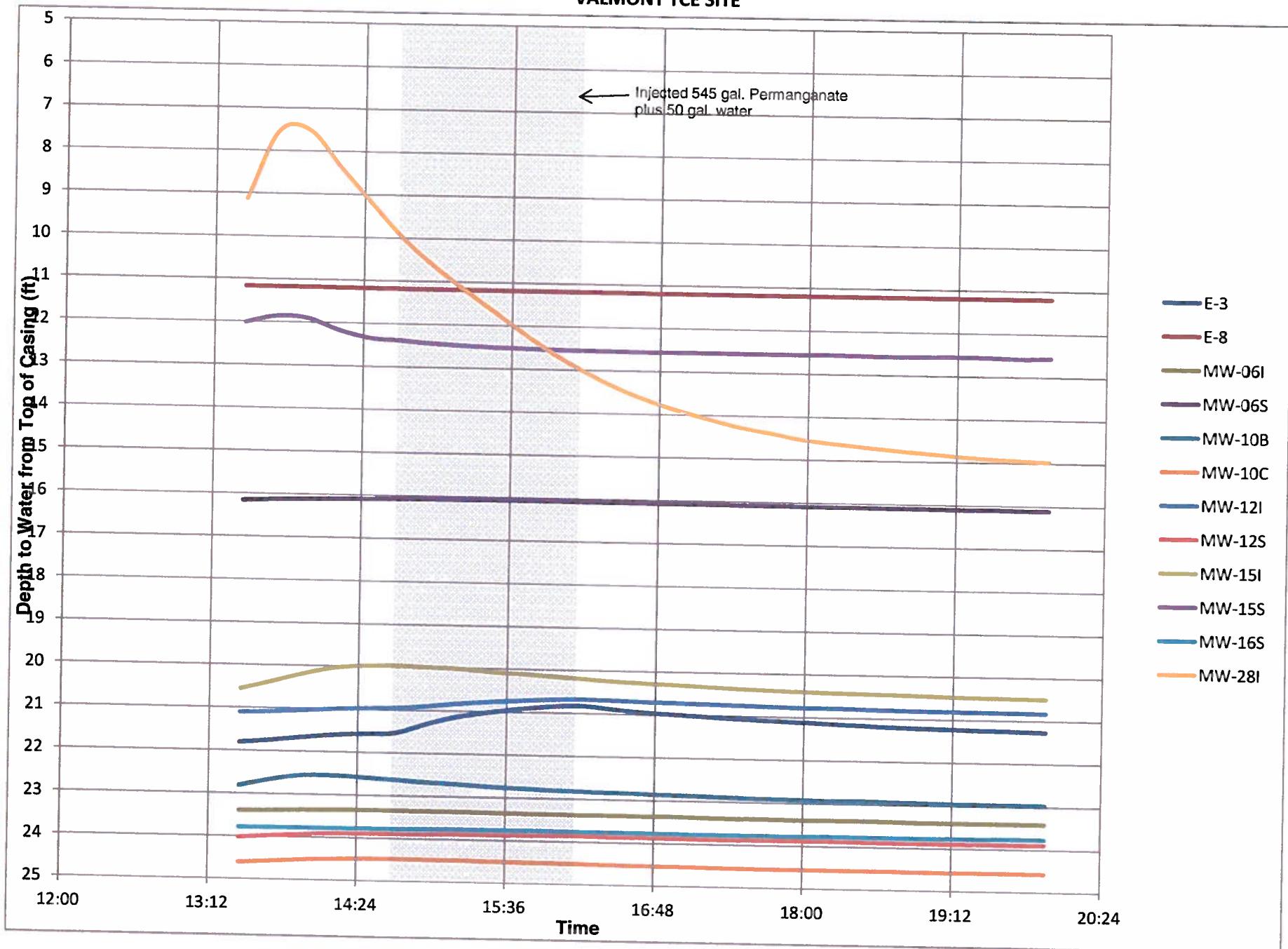
VALMONT TCE SITE



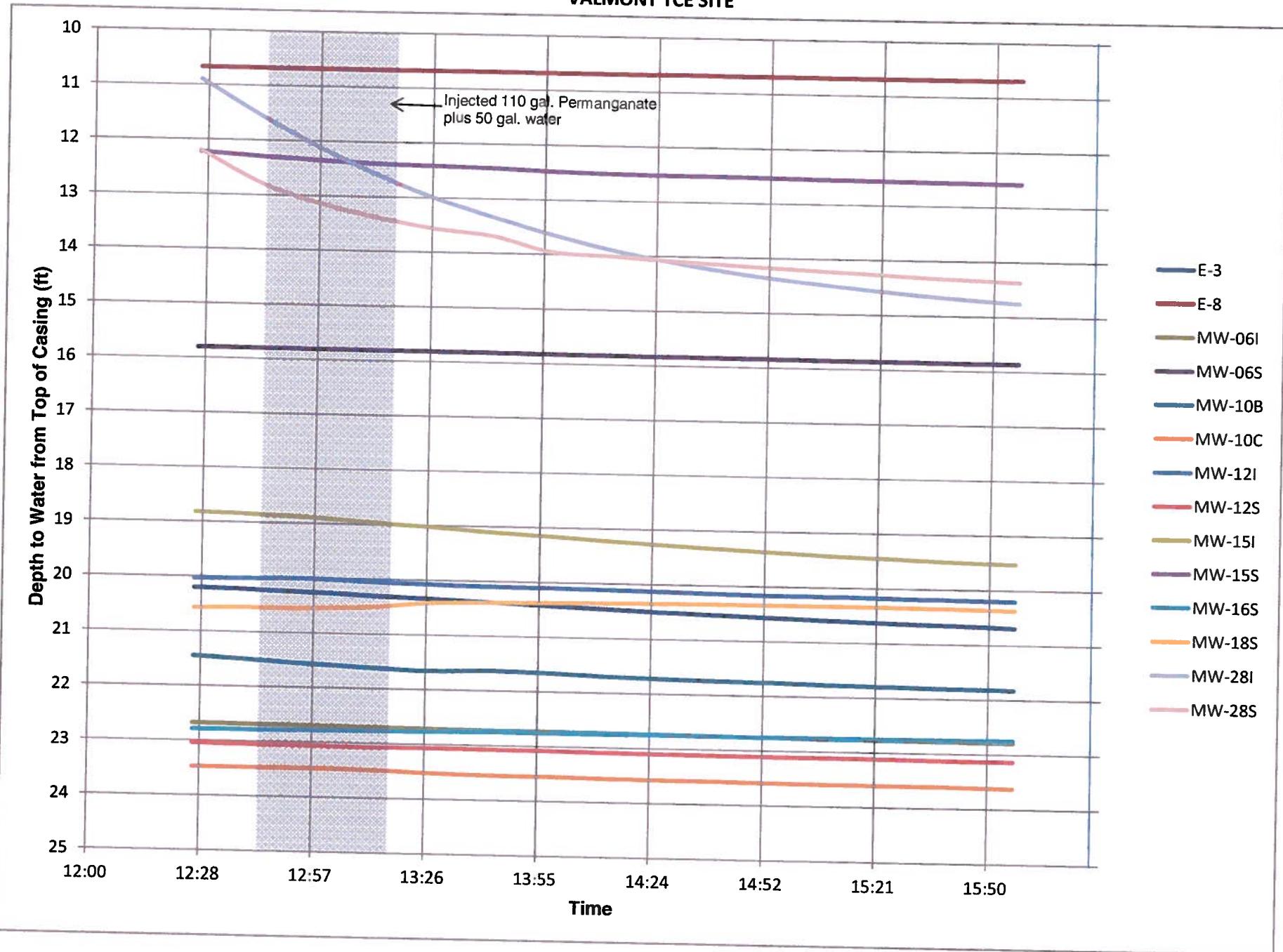
MW-18S INJECTION (16 FT-36 FT ZONE)

MAY 28, 2013

VALMONT TCE SITE



**MW-22D INJECTION (294 FT-304 FT ZONE)
MAY 23, 2013
VALMONT TCE SITE**



MW-28S INJECTION (35 FT- 45 FT ZONE)

MAY 28, 2013

VALMONT TCE SITE

